

REPORT

ON

VOCATIONAL EDUCATION IN INDIA

(Delhi, the Punjab and the United Provinces)

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Board of Education, England.)

WITH A SECTION ON

GENERAL EDUCATION AND ADMINISTRATION

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WHITEHALL,
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10th June 1937.

SIR,

We beg to submit to the Government of India the enclosed Report entitled " Vocational Education in India with a Section on General Education and Administration " which we have prepared as a result of the investigations which we made during our recent visit to India at the invitation of the Government.

We are, Sir,
Your obedient Servants,

A. ABBOTT.

S. H. WOOD.

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APPENDICES.

APPENDIX I.

The Curriculum, Accommodation and Equipment of a Junior Technical School.

Although each Junior Technical School draws up its own curriculum and syllabuses, the following, which are in use in a very successful English school of this grade, is typical of all of them.

CURRICULUM.

Summary of Time Table.

Subject.	1st Year.		2nd Year.		3rd Year.	
	45 min. periods.	Hrs. & Mins.	45 min. periods.	Hrs. & Mins.	45 min. periods.	Hrs. & Mins.
English ..	{ Lit. and Essay ..	5	{ 6—	{ 4	{ 5·15	{ 3
	{ History	2		{ 2		{ 2
	{ Geography	1		{ 1		{ 2
Mathematics	8	6—	7	5·15	6	4·30
Drawing ..	{ Geometrical ..	4	{ 6—	{ 2	{ 5·16	{ 2
	{ Machine	2		{ 3		{ 2
	{ Structural .. ..	..		{ ..		{ 2
	{ Art	2		{ 2		{ ..
Science ..	{ Appd. Mechs. ..	..	{ 3·45	{ 3	{ 6—	{ 3
	{ Physics	5		{ 2		{ 3
	{ Chemistry .. ..	..		{ 3		{ 3
Workshop	{ Metal	2	{ 4·30	{ 4	{ 4·30	{ 6
	{ Wood	4		{ 2		{ ..
	{ Materials and Processes ..	..		{ ..		{ 1
Physical Exercises	{ Gymnasium ..	2	{ 3·45	{ 2	{ 3·45	{ 2
	{ Games Field ..	3		{ 3		{ 3
Assembly and Prayers ..	..	50	..	50	..	50
Recreation .. ..	..	50	..	50	..	50
Totals ..	..	31·40	..	31·40	..	31·40

NOTES :

1. One half of one of the third year classes specialises in Toolmaking, and does an extra three periods in the workshop, losing thereby three periods of chemistry.

2. One third year class spends two periods in the Electrical Installation department, and loses thereby two periods of Metalwork.

SYLLABUSES.

English.

The aim of the instruction in this subject is to develop clear, concise expression in speech and in writing.

The syllabus is not given, since it is not suitable for use in Indian schools.

MATHEMATICS.

*1st Year Syllabus.**Arithmetic—*

Multiplication and division of decimals. Factorisation; L. C. M.; vulgar fractions (not too complicated).

Averages; ratio, proportion; conversions (*e.g.*, miles per hour to feet per sec.; lbs. per square inch to grams per sq. cm.); percentages, particularly percentage alterations such as in gain or loss, stretching of a wire, change of resistance of a conductor when heated.

Square root and theorem of Pythagoras.

Logarithms of numbers greater than 1, and use of these for products, quotients and square roots.

Mensuration—

Rectangle, parallelograms, rhombus, triangle (area by $\frac{1}{2}bh$ or by "s" rule) trapezoid, circle. Surface area and volume of cube, prism, cylinder, cone and sphere.

Algebra—

Meaning and use of symbols; coefficient, index, term, factor. Rules of signs. Addition, subtraction, multiplication, division. Simple fractions: simple equations and transpositions; simultaneous equations (two unknowns) Factorisation. Solution of Quadratics by factorisation and by completing the square.

Graphs—

Simple plotting (careful attention to style, choice of scales, etc.). Plotting of straight lines from their equations.

Trigonometry—

Meaning of sine, cosine and tangent; reading from the tables, solution of right-angled triangles.

Experimental Mechanics—

Plotting of position diagrams.

*2nd Year Syllabus.**Algebra—*

Revision of 1st year work, made more complete by practice in problems on that work. Harder fractions; literal equations; solution of quadratics by use of the formula; variation; arithmetical and geometrical progression; indices; general use of logarithms.

Trigonometry—

Revision and extension of work on solution of right-angled triangles; ratios of angles from 0° to 180° ; the co-ordinates of $^h x$ as $h \cos a$ and $h \sin a$; radius and length of arc.

Mensuration—

Revision of 1st year work, with technical bias to exercises. Length of chord of a circle; frustum of pyramid and cone; similarity. Easy problems on calculations of weights.

Geometry—

Line and angle properties of the circle.

Graphs—

Plotting of $y = ax^2 + bx + c$, $y = ax + bx + cx + d$, $xy = c$. Equation to a straight line
Areas by mid-ordinate rule.

Experimental Mechanics—

Displacement and velocity diagrams; change of velocity; motion of a falling body; trolley experiment; motion of a projectile; motion of a pendulum; vector balance experiments; momentum; force as the rate of change of momentum; Newton's Laws.

Slide Rule—

Use for multiplication and division.

*3rd Year Syllabus.**Algebra—*

Revision, indices and theory of logarithms, use of logs for negative powers; simultaneous equations (three unknowns); simultaneous quadratics.

Trigonometry—

Ratio of angles of any magnitude; solution of triangles by "sine" and "cosine" rules. Easy equations.

Graphs—

Sine, cosine and tangent curves; slope curves; graphic solution of equations; circle; ellipse; hyperbola, determination of laws of types $f(y) = af(x) + b$, $y = ax^n$; areas by Simpson's rule.

Calculus—

Meaning of $\frac{dy}{dx}$ and $\frac{dy}{dx}$.

Differentiation of ax^n , $\sin nx$, $\cos nx$, product and function of a function. Integration. An area as a definite integral.

Experimental Mechanics—

Angular Velocity; uniform motion in a circle; measurement of a blow; change of angular momentum; moment of inertia of bar and of cylinder.

Slide Rule—

General use with special attention to particular settings, e.g., volume of a cylinder, solution of triangles by sine rule, etc.

Applied Mechanics.

NOTE.—The study of this subject is not begun until the second year of the course.

*2nd Year.**Force—*

Definition and representation, summation of forces in straight line. Parallelograms, triangle and polygon of forces. Resultant, equilibrant and component forces. Velocity and acceleration.

Principle of Moments.—The lever; beam reactions.

Unit of Force.—Time. Work and Power. Gravity.

Variable forces.—Time and space averages.

Representation of work by area.

Horse power and Efficiency.—

Friction.—Co-efficient of friction; work done against friction; movement of bodies on inclined planes.

Machines—

Definition and types; velocity ratio; mechanical advantage; efficiency. Experiments with machines; calculations upon, and plotting of curves shewing characteristics of machines. Finding the law of a machine; using pulley on axle with thick and thin cords; wheel and axle; pulley blocks; Chinese windlass, screw-jack and Weston's blocks.

Strength and Characteristics of Materials.—Elementary notions.

Hydraulics.—Elementary notions.

3rd Year.

Materials—

The elastic law. Limit of proportionality. Stress, strain and modulus of elasticity. Compression and shear. Elementary ideas of ductility, brittleness and hardness. Resilience. Principal properties of common engineering materials.

Revision of reactions at supports of beams. Bending moment and shearing force diagrams for concentrated loads on cantilevers and simply supported beams. Stresses in the flanges of I-girders and rectangular beams due to bending moment.

Motion—

Revision of ideas of displacement, velocity, acceleration and vector representation. The fundamental relations between force, mass and acceleration (engineer's units). Momentum. Centrifugal force.

Energy—

Forms of energy. Conservation of energy. Flywheel and pendulum problems on work. Tractive effort, and work done on inclines.

Machines—

Revision of velocity ratio and mechanical advantage. Energy methods. Efficiency and consideration of shape of curves of performance.

Laboratory Work—

Boys work in groups of two. As far as possible, experimental confirmation follows the enunciation of principles in the class-room, but this is not always possible, and sometimes a simple experiment precedes class treatment. The methods of demonstration by teacher and selected boys is used when preferred.

Chemistry.

NOTE.—The study of this subject is not begun until the 2nd Year of the Course.

2nd Year.

Solution, evaporation, sublimation, distillation.

Crystallization, water of crystallization.

States and properties of matter.

Action of air on metals and of metals on air.

Rusting and combustion of metals and non-metals, leading to study of oxides, oxidation and reduction.

Chemical combination, atomic theory, elements, compounds, mixtures.

Laws of conservation of mass and of constant proportion.

Symbols, formulæ, equations.

Water as an oxide.

Electrolysis of water, leading to a study of hydrogen.

Electrolysis of hydrogen chloride, evolution of hydrogen from hydrochloric acid by electrolysis and by replacement by metals.

Action of metals on common acids, formation of salts by displacement of hydrogen.
Classes of oxides, acidic and basic oxides.

3rd Year.

Formation of salts by neutralisation, quantitative considerations.
Equivalent weights, atomic weights, valency.
Carbon dioxide, carbonates and bicarbonates as salts.
Chalk and lime; hardness of water.
Industrial applications of carbon dioxide—the ammonia-soda process.
Sulphur, its oxides and oxy-acids.
Nitrogen, ammonia, nitrates and nitric acid.
Law of Multiple Proportions.
Fuller study of hydrochloric acid and chlorine.
Avogadro's Hypothesis and Law of Gaseous Volumes
Common metals—iron, zinc, copper, lead, aluminium, chromium, etc.

Physics and Electrical Engineering.

NOTE.—The introduction to Electrical Engineering is postponed to the 3rd year.

1st Year.

The use of metre rules, calipers, vernier calipers, screw gauges, etc., for the measurement of length and volume.

General Physics—

Units of length, mass and time. Measurement of length; parallax. Micrometer Vernier. Measurement of areas (counting squares). Measurement of volume (graduated cylinder). The balance. Density of solids (measuring volume by graduated cylinder). Density of water. Density of liquids by specific gravity bottle. Principle of Archimedes. Specific gravity of solids heavier than water. Hydrometers. Pressure. Barometer. Hero's apparatus. Notes on capillarity.

Heat—

Production of heat and its effects. Heating and cooling curve of water. Flow of heat. Thermometers; fixed points of a thermometer; calibration; conversion of scales, Effect of mixing equal quantities of water at different temperatures. Effect of mixing unequal quantities of water at different temperatures. Water equivalent of Calorimeter. Specific heat of solids and liquids. Change of state. Latent heat of steam. Cooling curve of paraffin wax. Expansion of metals. Coefficient of linear expansion. Conduction. Effect of lagging a calorimeter. Convection and applications. Thermos flask.

Light—

Demonstration that light travels in straight lines. Laws of reflection. Position of image—plane mirror. Tracing the path of a ray of light through a block of glass.

2nd Year.

Heat—

Revision. Expansion of solids, liquids and gasses. Boyle's Law. Charles' Law.

Light—

Revision of Laws of reflection. Path of a ray through glass. Refractive index. Ratio of real and apparent depths. Reflection from spherical mirrors. Prisms. Spectrum. Lenses. Graphical construction for image. Bunsen photometer. Comparison of candle power of lamps.

Magnetism—

Properties of magnets. Comparison of magnet and magnetic substances. Molecular theory. Plotting magnetic fields by compass and by iron filings. Earth's magnetic field. Magnetic field due to current in a straight conductor and in solenoid. Magnetometer.

Electricity—

Preparation of Wires. Circuits and circuit diagrams. Electrolysis. Primary cells.

*3rd Year.**Electrical Engineering—*

The C. G. S. Units. Definition of the dyne and the erg. Revision of magnetism. Magnetic fields. Lines of magnetic force, their distribution and behaviour. Definition of field strength. Magnetic induction. Permeability. Resonance. Magnetic properties of iron and steel. Revision of electrolysis. Faraday's Laws of Electrolysis; applications. Revision of magnetic effects of current. Maxwell's Cork screw Rule applied to straight conductor, coil and solenoid. Electromagnets; their winding and use as compared with permanent magnets. Ohm's Law; difference between E. M. F. and P. D. of a Generator. Definition of the Ampere, Volt and Ohm, and their relation to the Electromagnetic Units. Calculations on Ohm's Law and measurement of the internal resistance of cells. Resistances in series and in parallel. Specific resistance. The simple Potentiometer. The Wheatstone Bridge. Metre Bridge. The Post Office Box.

Revision of Heat and its measurement. Specific Heat. Heating effect of a current. Relation between electrical energy and heat. Electric radiators, etc. Costs of running electrical apparatus. The Joule, the Watt, and the B. O. T. Unit. Measurement of electrical power. Instruments: Galvanometers, Ammeters, Voltmeters and the variation of their range with the aid of Shunts and Series Resistances. The construction, action, use and care of primary and secondary batteries. Electromagnetic induction. Faraday's and Lenz' Laws. Principle of the Electric Generator. Ring Armature; Commutator. Difference between A. C. and D. C. Principle of the Electric Motor; Fleming's Rules for Motor and Dynamo. Principle of the starter for a Motor. Elementary Principle of the Transformer and Induction Coil.

TECHNICAL DRAWING.

I

Practical Geometry.

NOTE.—This subject should be taught so as to assist the Machine Drawing, *i.e.*, rather as a means than as an end in itself.

*1st Year.**Plane—*

Use of instruments and appliances. Points, straight lines, perpendiculars, angles' Properties of triangles, proportionals, scales, regular and irregular polygons, areas, circles' and tangents to circles. Construction of the ellipse by several methods.

Solid—

Plain, elevation and ground line. Simple solids, cubes, prisms and pyramids (tri., sq., hex., oct.) cone. Use of end views. Simple sections of these solids. Isometric projection.

*2nd Year.**Plane—*

The ray method, involving points, lines and angles, curved and rectilinear figures, reduction to figures of equal area; construction of figures from given data; problems relating to circles and straight lines; simple problems on cams, loci and mechanism.

Solid—

Problems on points and lines introducing co-ordinate planes with end view. Indices, treated very simply. Points, lines, true lengths, inclinations and traces of lines mainly from given plan and elevation. Projection and auxiliary projection of simple and special solids. Perpendicular plane; sections cut by it; projection of rectilinear figures in inclined positions, and of solids involving the above from given data.

*3rd Year.**Plane—*

The conic sections treated very simply. Construction and properties of the ellipse; circles and tangents; problems involving ray method for reduction and enlargement of figures to equal areas. Problems on polygons, loci, cams mechanism and the helix.

Solid—

Revise work of previous years. Projection of solids from written data only. Sections and true forms of same; new views of solids to conditions of line, of face or axis in certain positions. Perpendicular and inclined planes and sections cut by them, also rebatements of figures on them. The oblique plane, traces, inter-sections; angles of inclination. Use of auxiliary ground line. Three points in plane. True angles between traces; dihedral angles of faces of pyramid. Use of indices and contours. Interpenetration of solids; two cylinders; and cylinder and cone; prism and pyramid and sphere and prism. Application to engineering problems—boiler shells, domes, connecting rods, etc. Isometric projection with curves. Development of surfaces.

II

MACHINE DRAWINGS.

1st Year.

Notes on pencils, paper and instruments. Fixing, heading and arrangements of work on paper. Use of squares. Lettering, figuring and dimensions.

Working drawings of the models to be made by the boys in the workshops are first produced. Other simple models are then sketched and drawn, attention being given to descriptive names and to the purposes the parts serve.

Importance is attached to neat and clear drawings and to the production of good lines, lettering and dimensioning.

2nd Year.

Talks are given on machine details, the functions of parts being explained; the materials used and the reasons for their choice will be given. Notes are given in screw threads—accurate shapes and conventional representation; standard proportions of bolts and nuts; types of bolt heads; bolt and nut, castle nut, etc.

Details such as riveted joints, spanners (with general idea of proportions), gland and stuffing box, simple valves, etc., are sketched, freehand and in pencil, from the actual articles and the sketches dimensioned after the articles are measured up. A schedule of parts is included where necessary; each view is named and each section plane indicated. Assembly and detail drawings with sections are prepared from the freehand sketches.

3rd Year.

The work progresses on lines laid down in the previous years. Special attention is given to correct dimensioning, good proportions and quality of lines.

The drawings to be made are chosen from common engineering details, connecting rods, valves, etc. Working drawings of workshop models are also prepared. Tracings of some drawings are made and each boy is taught blue printing.

Further talks on engineering details are given and drawing office organisation is discussed.

STRUCTURAL DRAWINGS.

NOTE.—This subject is intended to treat the various problems of structural engineering, and all the allied types of engineering where structures occur, by graphical solutions as used in the drawing office. This should assist any calculated investigation, and where possible, the alternative solutions are mentioned.

General—

Composition and resultant of parallel forces ; Bow's notation for describing forces ; resultant of system of parallel forces ; resultant of forces in any direction. General problems in frames using space diagrams, polar diagrams and the funicular polygon. Resolution and reactions with problems on beams and framed trusses.

Framed Structures—

Reactions for roof trusses and cantilever frames ; stress diagrams with problems on the most common framed structures ; effects of wind and oblique loads with examples shewing how the stresses may be combined or treated separately ; Warren girders, N girders, Pratt and Fink trusses with examples and problems on pent roofs.

Beams—

Graphical solutions for the reactions and the resultant load on a beam, with problems using concentrated and distributed loads or combinations of both. Shear and bending stresses in beams and how they are caused ; problems on the graphical construction of the shearing force and bending moment diagrams of a beam for concentrated, distributed or any form of loading. Laws of strength of solid rectangular beams ; neutral axis ; resistance figures and the moment of resistance with simple problems on the construction of these figures. The modulus of a beam and its application to problems for comparing a beam's strength.

WOODWORK.

1st Year.

The instruction will include the necessary drawing to scale. The work will be made from these drawings. Sketching from models will form an important part of the early training.

Construction and uses of the various tools and methods of manipulation.

Nature and properties of the various kinds of timber.

The following exercises and models will be worked upon. Each exercise is so arranged that a progressive tuition in the use of tools, and in the making of models and patterns is obtained.

Sawing and chiselling exercises.

Housing groove and torque joints.

Dovetail halving and bridle joints.

Inlay square on diagonal.

Pattern and core box for a bush.

Pattern for a fire bar.

2nd Year.

Models and joints of a more complex character, introducing new tools and methods of construction.

Elementary pattern making. Wood turning, use of various machines, such as band saw, circular saw, planer.

The use of patterns and draw will be demonstrated with moulding sand. The following models and patterns will be made :—

Mortise and tenon joints.

Pattern for :—

- Base of surface gauge.
- Surface plate.
- Small hand wheel.
- Plummer block, with cap.
- Wall brackets.
- Bottle jack.
- Spur wheel.
- Large hand wheel.
- Pipe joint with core box.

WORKSHOP MATERIALS AND PROCESSES.

3rd Year only.

<i>Engineers' Tools</i>	..	..	Uses and descriptions.
<i>Smiths' Tools</i>	..	..	Uses and description. Welding. Hardening and tempering. Power hammers, etc.
<i>Machine Tools</i>	..	..	Diagrams shewing arrangements. Centre Lathe. Details, tools and tool slides; making, hardening and tempering tools for special purposes. Calculations on screw cutting, and trains of wheels. Calculations of speeds and feeds for work. Type and proportions of screw threads, and various methods of cutting threads.
<i>Files</i>	..	..	Manufacture and types.
<i>Emery Wheels</i>	..	..	Manufacture, types, calculation of speeds.
<i>Transmission of Power</i>	..	..	Various forms of mechanical power transmission. Belts gears, ball bearings, clutches. Gear cutting, Chain drives. Calculation for gears. Notes on dividing head for gear cutting.
<i>Keys and Feather</i>	..	..	Types, uses, method of fitting, sliding fits, driving fits, etc.
<i>Workshop hints</i>	..	..	General talks.
<i>Materials</i>	..	..	Materials used in engineering work. Iron ores. Manufacture of pig iron, grey iron, mild steel, cast and alloy steels. Non-ferrous metals with proportions of constituents.
			Methods of casting, forging, stamping, etc.
			Sketches of furnaces, cupolas, etc.

ENGINEERING WORKSHOP PRACTICE.

THREE YEAR COURSE.

1st Year (one period of $1\frac{1}{2}$ hours weekly).

Elementary operations and processes such as soldering, marking out (two dimensional only), filing and polishing, chiselling, drilling, metal bending, light riveting, etc., are covered by such models as the following :—

1. (a) Simple lap joint using tin plate.
(b) Simple lap joint using any unprepared material—the joint to be tested on completion.
2. Riveted prism with cover plate joint.
3. Iron hinge.
4. Internal and external 90° angle gauge.
5. Ring spanner.
6. Hexagonal gauge.

2nd Year (two periods of $1\frac{1}{2}$ hours weekly).

More advanced work including marking off (three dimensional), tapping and the use of stocks and dies, hardening and tempering, case hardening, the assembly of parts, etc. The use of the lathe—plain turning, centring in three and four jaw chucks, turning between centres. Knurling and turning to size for screwing, and more advanced drilling practice are dealt with in this year. The models made include 1" cube, centre punch, square carrier, calipers, tap wrench, depth gauge and square.

In the first and second years, talks upon the various processes involved in the work are given in the shop in conjunction with the practical work. The boys make their own notes and for homework record them in a special note book.

3 Year ($4\frac{1}{2}$ hours on one day a week).

The general third year course covers advanced bench work, fitting and assembly of parts and the use of such precision instruments as micrometer and vernier. The machines used are :—

Lathes of various types.

Work is of greater precision than in the second year and includes screw cutting.

Milling machines (both horizontal and vertical).

The use of the dividing head in milling is taught.

Shaping machines.

Drilling machines. Power saw, etc.

Grinding machines.

Besides using these machines, the boys are taught how to mark out and set up a job correctly.

The models made include toolmaker's clamps, toolmaker's vice, surface gauge, adjustable spanner, square and vee thread taps, reamers, vee blocks, stock and die, lifting jack, spiral fluted reamer, large clamps and small bench vice.

Demonstrations in oxy-acetylene and electric arc welding are given.

During this year a weekly lecture of 45 minutes duration is given on Materials and Processes (See separate syllabus).

A group of selected boys spend an extra half day per week in the machine shop when they receive some specialised instruction in tool-making. These boys make various small tools, gauges and simple press tools.

ENGINEERING WORKSHOP PRACTICE.

ALTERNATIVE SCHEME.

Two Year Courses.

The following scheme of instruction in engineering workshop practice is less ambitious than the one previously described.

It occupies two years only, and each boy is expected to spend from three to six hour a week in the metal workshop.

<i>Range of Materials</i>	..	..	Wrought iron, mild steel, carbon tool steel, cast iron, cooper, aluminium, zinc, brass.
<i>Range of Processes</i>	..	(a) <i>Hand Processes—</i>	Cutting with snips, hacksaw and chisel. Chipping, filing, scraping and polishing. Screwing with taps and dies. Sheet—metal work—forming, beading, riveting. Forge work—drawing down, bending, upsetting. Hardening, tempering and annealing. Marking out.
		(b) <i>Machine Processes—</i>	Drilling with Brace, Sensitive and Pillar drills. Sliding, surfacing and taper turning in Centre. Lathe. Shaping. Simple tool grinding. Screw cutting.* Milling.*
<i>Range of Machine Tools</i>	..	..	Drills : Centre Lathes : Shapers : Tool Grinders : Power Hacksaw. * Miller.*

*NOTE— For those pupils who take a longer course than that covered in two years.

Accommodation and Equipment of a Junior Technical School—

The ordinary accommodation of a Junior Technical School should be like that of a Higher Secondary School. In addition, it needs a large science laboratory (about 1,000 square feet), a Woodwork room (at least 800 square feet) and an Engineering Workshop (at least 1,000 square feet).

The *Laboratory* should be equipped in the same way as a Physical laboratory usually is, but it should have one or more blank walls on which apparatus can be fixed. It is desirable that there should be one or more light girders fixed across it at a height of seven or eight feet, so that apparatus can, when necessary, be suspended from it.

It is an advantage to have a small chemical laboratory also, though this is not absolutely necessary, since the amount of chemistry included in the curriculum is small.

The Woodwork room should have properly fitted carpenter's benches for about 24 pupils. Space is needed for a lathe and a grindstone ; and there should be a store for timber and for the articles made by the pupils. A blackboard should be attached to one of the end walls.

The *Engineering Workshop* should have the following equipment, which is sufficient for classes of 20—25 pupils :—

- Benches with 24 vices.
- 2 Forces with anvils and tools.
- 1 Sensitive drill (pillar or bench type).
- 1 Pillar drill up to $\frac{3}{4}$ inch.
- 5 Centre Lathes, mainly 6 inch.
- 1 Shaper, 10 or 12 inch.
- 1 Tool grinder.
- 1 Power hacksaw.
- 1 Miller.*

This equipment, which is suitable for the "Alternative Scheme" described in this Appendix, would cost about £1,000. This estimate includes the provision of separate electric drives for the machine tools, and also of the miller and its accessories.

* For the use of pupils taking a longer course.

APPENDIX II.

THE ELEMENTS OF COMMERCE.

The following syllabus is suggested for consideration by teachers of this subject.

*First Year.**Retail Trade—*

- (a) The organization and functions of a retail business.
- (b) The purchase of goods from wholesale dealer or the manufacturer. Price lists. Trade Discount. Invoices. Methods of payment:—cheques, money orders, postal orders. Profits:—gross profit, working expenses, net profit. Turn-over. The relation of net profits to turn-over. Net profit divided into (i) remuneration of management, (ii) interest on capital.
- (c) Simple explanation of the banking system. Current and deposit accounts. The Bankers' Clearing House.

Wholesale Trade—

- (a) The wholesale warehouse. Its organisation and functions. Purchase and sale of (i) manufactured goods; (ii) raw materials and foodstuffs. Carriage of goods and its cost (using official tables). Terms of payment. Inland bills of exchange and promissory notes.

Throughout the instruction arithmetical exercises should be set wherever possible; and examples of the documents used should be available as illustrations.

Second Year.

The work in this year will be mainly a repetition of that done in the first year, but it will deal in greater detail with the various topics.

(a) The constitution of the firm.—

- (i) The sole trader.
- (ii) Partnership; its legal and economic aspects. The various modes of remuneration of partners.
- (iii) The Company with liability limited by shares—the Memorandum and Articles of Association; the nominal or authorised capital; the subscribed capital; the called-up capital and the paid-up capital. The division of capital into various classes of shares. The borrowing of capital by means of Debentures. The transfer of shares (or stock) and Debentures (or Debenture stock). The Private Company. Co-operative societies.

(b) Co-operation amongst business units.

- (i) Conformity with the conditions of purchase and sale laid down by an association of traders.
- (ii) The association of business units into Kartels formed with the object of limiting or excluding competition within a defined market by either—the allocation to each business of a specified area of the market; the fixing of minimum selling prices within the market; or the establishment of a separate selling organisation for the market.
- (iii) Combines or Trusts. The combination of individual business units into larger units.

(c) Money and Exchange.

Money as a medium of exchange: effects of variations in its purchasing power.
The Indian monetary system.

Joint-stock banks: bank notes and deposits as substitutes for metallic currency: the limitations on the issue of bank notes. Methods of opening and operating a banking account: classes of accounts.

(d) *Export Trade.*—

Means of procuring orders: quotations: indents: functions of merchants, shippers, packing and forwarding agents; documents relative to shipping and insurance.

(e) *Import Trade.*—

Functions of import merchants and brokers; procedure in obtaining delivery of dutiable and non-dutiable goods; bonded warehouses. General knowledge of the methods of payment relating to exports and imports.

APPENDIX III.

Occupations taught in the Trade Schools of the Paris Chamber of Commerce.

(NOTE :—Only the main groups are mentioned, although a number of them include several separate trades.)

<i>For Boys.</i>	<i>For Girls.</i>
Blacksmith's work.	Flower making.
Engineer's fitting.	Embroidery.
Tinsmith's work.	Dressmaking.
Metal plate work.	Lingerie.
Engineer's Patternmaking.	Millinery.
Moulding.	Lacemaking.
Printing, including :	Corset making.
Typography,	Furrier's work.
Lithography,	Dyeing.
Photogravure.	
Bronze casting.	Cleaning of textile goods.
Art metal work (iron).	Laundry.
Stone carving.	Domestic crafts.
Scientific instrument making	Retail selling.
Surgical instrument making.	
Tailoring.	
Carpentry and Joinery.	<i>For Boys and Girls.</i>
Plumbing.	Stationery manufacture.
Glazier's work.	Cardboard work.
Cabinet making.	Book-binding & gilding.
Pottery.	Leather work, including the manufacture of
Butcher's work.	Purses,
Baking.	Ladies' bags,
Cookery (chefs).	Suit cases.
Grocery.	
Confectionery.	
Hotel work.	
Retail selling, including :	
Ironmongery,	
Haberdashery.	

APPENDIX IV.

Suggested Courses of Instruction for Part-time Students.

It will be noted that the following courses of instruction, being intended for students who are already in employment, include no instruction in workshop practice. They are intended to be complementary to this, and invariably include mathematics, drawing and science, although the content of the syllabuses of instruction in these subjects differs in accordance with the nature of the industry in which the students are engaged.

The teaching of science, in particular, assumes new forms when workshops, originally intended for the purpose of producing goods, are employed as laboratories. The students should not be concerned as a rule with learning the ordinary methods of production, but with becoming familiar with the principles underlying production. For example, students of cotton spinning should not attempt to turn out great quantities of yarn, but should undertake the systematic investigation of the way in which the various functions of cleaning the raw material, attenuating, twisting it, etc., are performed by the different machines, and should concentrate on ascertaining the effect on the product of the variations which they make in the adjustment of the different elements] constituting the complete machine. In this instance, science has become what is termed "technology". The method is scientific, but its form is different from what it usually is in the laboratory.

MECHANICAL ENGINEERING COURSE.

First Year.

Mathematics.

Engineering Drawing.

Engineering Science.

Second Year.

Mathematics.

Engineering Drawing.

Engineering Science.

Third Year.

Mathematics.

Applied Mechanics.

One of the following :—

Heat Engines.

Engineering Drawing.

Electrical Engineering.

Mathematics.

In this subject, the general principles should first be taught; this should be followed by abundant practice in their application to such practical problems as come within the range of understanding of the students.

It is important that from the first the students should be trained in the use of graphs for both the representation of varying quantities and the solution of equations. In the second year, students should be introduced to the idea of differentiation, while in the third year they should acquire a fair knowledge of the elements of the calculus and should be taught to apply it to determining area, centre of area, Guldinus' Theorem, moments of inertia, etc.

Engineering Drawing.—

The main object of the instruction in this subject is to enable students to "read" an engineering drawing, that is, to visualise machine details from a drawing giving two or more views.

The most important part of the instruction is probably the making of dimensioned hand-sketches from actual machine details, of which there should be a plentiful supply available. From these sketches, plans and elevations should be made to scale, and these views should be combined to complete isometric drawings of the examples. The mere copying of drawings should be avoided.

Engineering Science.

Since every mechanical engineer should have some knowledge of electro-technics, the elementary treatment of this subject is included in the course. Engineering science includes the study of force, work and friction, machines, electro-technics, energy and power.

In Electro-technics, students should gain an acquaintance with: magnetising force, magnetic field strength, electro-magnets, magnetic field of a simple machine, potential difference, electro-motive force, Conducting and insulating materials. Resistance of conductors; resistivity. Units—the ohm, ampere, coulomb, volt. Ohm's Law. Simple and divided circuits. Principles and use of galvanometers, ammeters and voltmeters.

COTTON SPINNING COURSE.

First Year.

Cotton Spinning.
Textile Mathematics.
Textile Drawing.

Second Year.

Cotton Spinning.
Textile Mathematics.
Textile Science.

Third Year.

Cotton Spinning.
Textile Mathematics.
Textile Science.

Cotton Spinning.

The instruction in this subject should begin by giving the students in their first year a general view of the whole of the processes from the opening and cleaning of raw cotton to its spinning on ring frames and on mules. While the various mechanisms should not be discussed in great detail, students should have exact notions of the functions they perform in the long series of operations involved in the transformation of raw cotton into finished yarn.

In the Second and Third Years, the machines and the several functions which each of them is performing should be studied in detail.

Textile Mathematics.—

Students of cotton spinning need not carry their knowledge to such an advanced stage as students of mechanical engineering, but, so far as it goes, their knowledge of mathematics should be thorough. They should be familiar with algebra, the use of logarithms, the elements of trigonometry and the use of graphs; and they should be accustomed to applying their skill to the calculations required in spinning.

Textile Drawing.—

The instruction in this subject should enable students of cotton spinning to understand drawings of textile machinery, and to make suitable dimensioned sketches of simple parts of spinning machinery. Necessarily, the machine details used should be those found in a spinning mill.

Textile Science.—

The instruction in this subject should include the more elementary scientific principles needed in order to understand the materials and the operations of the spinning mill.

It should include a knowledge of—solids, liquids, gases; pressure and volume; Boyle's Law; the barometer; the principles of Archimedes; capillarity and surface tension.

Friction; co-efficient of friction; the advantages and disadvantages of friction; work done in overcoming friction; oils and lubrication; the use of ball and roller bearings.

Heat and temperature; expansion of solids, liquids and gases; the thermometer; Charles' Law; change of state; melting and boiling points; vapour pressure; humidity; wet and dry bulb thermometers; specific and latent heat; conduction, convection and radiation.

Work and energy; the principle of work; power; efficiency of the machine.

The principle of moments; weighing machines.

Stress and strain; Hooke's Law, fatigue of materials.

Dynamics; Newton's laws of motion; falling bodies; kinetic energy; momentum; centrifugal force.

Horse-power; work transmitted by the effective tension of a rope or belt.

Machines; mechanical advantage and efficiency.

Communication of motion; belt driving and velocity ratios of simple and compound straight drives; the convexity of pulley rims, the effect of slip on velocity ratios; tooth gearing; the velocity ratio of a simple and compound train of wheels; differential motions; chain drives, worm drives, and racks; calculations on the surface speeds of rollers and drafts between rollers; intermittent motion driven from ratchet wheels.

These two courses of instruction for part-time students have been described in some detail because they are constituted rather differently. The course in mechanical engineering cannot be regarded as possessing a central subject. It consists of three subjects—mathematics, drawing and science—which are cognate to each other. The course in cotton spinning differs from it in having a central subject—cotton spinning—with which are associated the ancillary subjects of mathematics, drawing and science.

It will be found that every grouped course of part-time instruction will have a general resemblance to either one or the other of these two main types.

ERRATA.

Page 2—

Line 28—After “required” *insert* comma.

For Comma after “suggest” *substitute* “:—”.

29—For “of institutions” *read* “of institution”.

41—After “countryside” *insert* “end quotation”.

Page 3—

Line 3—For “State” *read* “Stage”.

5—For “higher secondary” *read* “Higher Secondary”.

6—After “Stage” *insert* dash.

14—After Degree *insert* comma.

Page 5—

Line 19—*Delete* “of” at end.

Page 9—

Para. 2, Line 1—For “numbor” *read* “number”.

Para. 5, Line 1—After “insuperable” *insert* comma.

Para. 5, Line 3—For “acquiesee” *read* “acquiesce”.

Para. 6, Line 6—*Delete* comma after “efforts”.

Page 10—

Para. 7, Line 5—For fullstop after “particular” *read* “comma”.

Para. 7, Line 8—After “countries” *insert* comma.

Para. 10, Line 7—After “upon them” *insert* comma.

Para. 11, Line 1—For “fee” *read* “few”.

Page 11—

Para. 12, Line 12—For “learing” *read* “learning”.

Para. 13, Line 3—For “send” *read* “seed”.

Page 12—

Para. 17, Line 5—After “view” *insert* comma.

Para 18, Line 17—*Delete* comma after “education”.

Para. 19, Line 2—For “consideration” *read* “considerations”.

Para. 19, Line 3—For “it” *read* “in”.

Para. 20, Line 2—After “tired” *insert* comma.

Page 13—

Para. 22, Line 2—For “lower” read “Lower”.

Para. 22, Line 5—For “it” read “is”.

Para. 24, Last Line—For “actute” read “acute”.

Page 15—

Para. 29, Line 6—After “uplift” insert “end quotation”.

Pages 15-16—

Para. 33, Line 5—Delete comma after “serve”.

Page 16—

Para. 35, Line 6—For “fruther” read “further”.

Para. 35, Line 10—After “range” insert comma.

Para. 35, Line 11—After “history” insert comma.

Page 19—

Para. 45, Line 1—For “varnacular” read “vernacular”.

Para. 46, Line 7—For “English, is” read “English is”.

Para. 48, Line 1—For “connot” read “cannot”.

Page 20—

Para. 50, Line 1—For “Schools of” read “Schools, if”.

Para. 50, Line 2—For “live” read “life”, and after “conversation” insert comma.

Page 21—

Para. 55, Line 8—For “satisfaction” read “satisfactions”.

Para. 56, Line 2—For “of some” read “or some”.

Page 22—

Para. 60, Line 2—For “painting particularly,” read “painting, particularly”

Para. 61, Line 3—For “been” read “seen”.

Page 24—

Para. 67, Line 7—Insert comma after “development”.

Page 26—

Para. 75, Line 8—For “behavior” read “behaviour”.

Para. 76, Line 5—After “teacher” insert comma.

Page 27—

Para. 79, Line 11—*Delete* Comma after “ withdrawn ”.

Para. 79, Line 13—After “ alive ” *insert* comma.

Page 28—

Para. 81, Line 4—For “ doing a good ” *read* “ doing good ”.

Para. 82, Line 8—For “ agreement ” *read* “ agreements ”.

Pages 29-30—

Para. 88, Line 8—For “ premanence ” *read* “ permanence ”.

Page 30—

Para. 91, Line 5—For “ classroom ” *read* “ classrooms ”.

Page 32—

Para. 97, Line 10—For “ living soceity ” *read* “ living society ”.

Page 33—

Para. 98(c), Line 3—For “ is ” *read* “ it ”.

Para. 98(g), Line 1—For “ piad ” *read* “ paid ”.

Page 40—

Para. 8, Line 2—For “ at ” *read* “ as ”.

Page 47—

Para. 25, Line 11—For “ colon ” *read* “ fullstop ”.

Page 49—

Para. 31, Line 8—*Insert* comma after “ instructions ”.

Page 49—

Para. 32, Line 3—For “ point ” *read* “ joint ”.

Page 50—

Para. 33, Line 2—For “ Chambers ” *read* “ chambers ”.

Page 53—

Para. 47, Line 4—For “ taxed ’ apprentissage ” *read* “ taxe d’apprentissage ”.

Page 55—

Para. 52, Line 4—For “ completed ” *read* “ complete ”.

Page 55—

Para. 54, Line 8—For “examination” read “Examination”.

Pages 55-56—

Para. 55(a), Line 13—Insert “the” before “great”.

Para. 55(a), Line 25—For “bases” read “basis”.

Pages 55—57—

Para. 55 (b) (i), Line 1—For “on” read “an”.

Pages 55—57—

Para. 55 (b) (ii), Line 1—For “technical schools” read “Technical Schools”.

Page 57—

Para. 56, Line 1—For “school” read “schools”.

Para. 56, Line 10—For “acquainted” read “acquainted”.

Page 58—

Para. 61, Last Line —For “uthorities” read “authorities”.

Page 59—

Para. 63, Line 2—For “realised” read “realise”.

Pages 59-60—

Para. 65, Line 14—For “educations” read “education”.

Page 60—

Para. 68, Line 6—Insert comma after “examination”.

Pages 60-61—

Para. 68(a), Line 1—Insert comma after “attendance”.

Para 68(d), Line 1—Insert comma after “(calculated weekly)”.

Page 62—

Para. 72, Line 18—For “enagaged” read “engaged”.

Page 62—

Para. 74, Line 6—Insert fullstop after “Trade Schools”.

Pages 62-63—

Para. 74, Line 19—Insert “is” after “them”.

Para. 77(a), Line 2—For comma read semicolon after “workshop”.

Page 64—

Para. 79, Line 3—For “Committee” *read* “Commission”.

Pages 64-65—

Para. 80, Line 7—For “skilll” *read* “skill”.

Page 65—

Para. 81, Line 5—*Insert* comma after “and”.

Page 66—

Para. 84, Line 1—For “centres, only” *read* “centres only”.

Para. 86 (*d*), Line 6—For colon *read* fullstop after “widespread”.

Page 67—

Para. 87, Line 17—*Insert* comma after “curriculum”.

Page 68—

Para. 90, Line 5—For “fitting” *read* “Fitting”.

Page 69—

Para. 94, Heading—For “Relationship” *read* “Relationships”.

Page 70—

Para. 96, Line 9—*Delete* fullstop after “acquaintance”.

Line 11—For “problem” *read* “problems”.

Line 12—For “meta” *read* “metal”.

Page 73—

Para. 102, Line 15—For colon *read* semicolon.

Page 77—

Para. 112, Line 9—For “Corrects” *read* “correct”.

Page 79-80—

Para. 118, Line 15—For “school” *read* “schools”.

Line 44—For “school” *read* “School”.

Page 80—

Para. 118(*a*), Line 2—*Insert* “the” after “at”.

Page 81—

Para. 119, Line 3—For “principels” *read* “principals”.

Page 84—

Para. 125(a), Line 1—For “service” *read* “services”.

Para. 125(b), Line 5—*Insert* commas after “persons” and “concerned”, respectively.

Line 21—For “tachnology” *read* “technology”.

Line 22—For “town” *read* “towns”.

Page 84-85—

Para. 126, Line 31—For “School” *read* “Schools”.

Para. 126, Line 32—For “preferabe” *read* “preferable”.

Page 85—

Para. 127, Line 3—*Insert* hyphen after “handicrafts”.

Page 86—

Para. 131, Line 1—*Delete* “to”.

Page 91—

Para. 147, Line 5—For comma *read* colon.

Page 93—

Para. 156, Line 13—For “students” *read* “student”.

Page 94—

Para. 160, Line 1—For “principal” *read* “Principal” in both places.

Pages 94-95—

Para. 161, Line 31—For “necessary” *read* “necessary”.

Page 95—

Para. 162, Line 5—For “textile” *read* “textiles”.

Page 96—

Para. 165, Line 13—For “lest” *read* “least”.

Pages 98-99—

Para. 174, Line 15—For “recruting” *read* “recruiting”.

Page 99—

Para. 175, Line 4—For “employees” *read* “employers”.

Pages 101-102—

Para. 184, Line 9—For “or” *read* “of”.

Page 104—

Para. 196, Line 2—For “institutions” *read* “institution”.

Para. 196, Lines 3-4—For “necessary” *read* “necessary”.

Page 106—

Para. 207(a), Line 2—After “be” *insert* “to”.

Page 108—

Para. 212, Line 2—After “he” *insert* “or she”.

Pages 108-109—

Para. 214, Line 18—For “aptitude” *read* “aptitudes”.

Page 109—

Para. 215 (3), Line 1—After “graduates” *insert* fullstop.

Page 109—

Para. 215 (3), Line 9—*Delete* comma after “interests”.

Page 112—

Para. 21, Line 12—For “(a) Agriculture” *read* “(c) Agriculture”.

Page 115—

Para. 43, Line 1—For “technical” *read* “Technical”.

Pages 115-116—

Para. 43, Line 10—For “provinces” *read* “Provinces”.

Page 117—

Para. 49, Lines 4-5—For “skillfully” *read* “skilfully”.

Para. 51, Line 1—For “Commerces” *read* “Commission”.

Para. 51, Line 2—For “inspecting service” *read* “Inspecting Service”.

Page 118—

Para. 59, Line 16—For “(e)” *read* “(c)”.

Pages 118-119—

Para. 59, Line 19—For “Teachrs” *read* “Teachers”.

Page 121—

Para. 121, Line 17, Col. 5—Against “Drawing” for “5·16” *read* “5·15”.

Para. 122, Line 6—For “METHEMATICS” *read* “MATHEMATICS”.

Line 40—For “radiaus” *read* “radians”.

Page 123—

Line 19—For “axn” read “axⁿ”.

Page 124—

Line 29—For “methods” read “method”.

Line 45—For “hydrogen chloride” read “hydrogenchloride”.

Page 125—

Line 25—For “Here’s” read “Hare’s”.

Page 127—

Line 25—For “arrangements” read “arrangement”.

Line 27—For “Workshops” read “Workshop”.

Page 128—

Line 2—For “DRAWINGS” read “DRAWING”.

Line 6—For “nhe” read “the”.

Page 130—

Line 25—For “3” read “3rd”.

Line 41—For “are” read “are”.

Page 131—

Line 6—For “hour” read “hours”.

Line 33—For “800” read “900”.

Page 133—

Line 23—For “deail” read “detail”.

Page 136—

Line 26—For “if” read “of:”.

Page 137—

Line 41—For “trignometry” read “trigonometry”.

Page 138—

Line 24—For “drived” read “derived”.